3D image display devices such as that disclosed in (for example) USP 5,327,285 have been proposed in the past. In this 3D image display device, as is shown in Figure 1, a film 52 in which right-eye image display parts *a* and left-eye image display parts *b* are alternately disposed side by side is bonded to the surface of a liquid crystal member 51. When the light emitted by the aforementioned liquid crystal member 51 is controlled so that a specified image is displayed, a right-eye image is displayed from the right-eye image display parts *a*, and a left-eye image is displayed from the left-eye image display parts *b*. Furthermore, since [the device] is constructed so that the direction of vibration of the polarized light constituting the right-eye image from the right-eye image display parts *a* has an angle of 90° relative to the direction of vibration of the polarized light constituting the left-eye image from the left-eye image display parts *b* (i.e., since [the device] is constructed so that (for example) the x component of the right-eye image consisting of two components x and y has a phase difference of 180° (π) with respect to the x component of the left-eye image which similarly consists of two components x and y), the observer can experience the sensation of observing a three-dimensional image when the aforementioned image is viewed using polarizing eyeglasses consisting of a polarizer-equipped right-eye lens that transmits only the right-eye image and a polarizer-equipped left-eye lens that transmits only the left-eye image.

[0003]

As has been disclosed earlier in Figure 2 of the aforementioned USP 5,327,285, such a film 52 in which the aforementioned right-eye image display parts *a* and left-eye image display parts *b* are alternately disposed side by side is manufactured by a chemical treatment method in which a polarizing film formed by laminating a TAC film (triacetylcellulose film) and an iodine-treated drawn PVA film (polyvinyl alcohol film) is coated with a photoresist, after which specified portions [of the film] are exposed, and these portions are then treated with a potassium hydroxide solution, so that the property that the drawn PVA film has of being able to rotate the direction of vibration of light in a specified wavelength region while maintaining the linearly polarized state [of the light] "as is" (phase-difference function) is eliminated, or by a physical treatment method in which specified portions of the above-mentioned polarizing film are removed by means of a diamond cutter, so that the above-mentioned property is eliminated only in these portions, etc.

[0004]

However, the former chemical treatment method is a method in which the above-mentioned property of the drawn PVA film is eliminated by treatment with a chemical solution (potassium hydroxide solution), and thus suffers from a drawback in that the boundary between the portions in which the above-mentioned property is eliminated and the portions in which the above-mentioned property is not eliminated is unclear. In this regard, the latter physical treatment method does not suffer from such a drawback, and is therefore superior to the chemical treatment method; however, the above-mentioned method in which a diamond cutter is used suffers from the following drawbacks:

[0005]

The diamond cutter is formed by bonding a diamond powder to the circumferential edge of a rotating metal blade by means of an adhesive agent, and when this cutter is caused to contact the object that is being cut, the adhesive agent is removed as a result of frictional heat, etc., so that the diamond powder embedded in the adhesive agent is exposed, and thus exhibits a cutting effect.

[0006]

However, when the object that is being cut consists of a synthetic resin material, this synthetic resin material melts during cutting and adheres to the diamond powder; furthermore, the removal of the adhesive agent may be inhibited, so that the exposure of the diamond powder is suppressed, thus causing a drop in the cutting capacity.

[0007]

Accordingly, in cases where a diamond cutter is used to form grooves in the above-mentioned polarizing film, the productivity is markedly inferior.

[0008]

The present invention provides a method for efficiently manufacturing a 3D image display body in which right-eye image display parts *a* and left-eye image display parts *b* are mixed, and which has a good function.

[0009]

[Means Used to Solve the Above-mentioned Problems]

The gist of the present invention will be described below with reference to the attached figures.

[0010]

[The present invention] relates to a method for manufacturing a 3D image display body which is used to display 3D images in which right-eye image display parts *a* and left-eye image display parts *b* are mixed, said 3D image display body manufacturing method being characterized by the fact that [a] a phase-difference film is disposed on a transparent support 1 with an adhesive agent 2 interposed, [b] specified portions of the above-mentioned phase-difference film are then cut away by means of an ultra-hard blade 4, so that a plurality of grooves 8 that extend from one side [of the phase-difference film] to the other are formed side by side in the phase-difference film, and [c] a display member 5 is then superimposed on or bonded to the phase-difference film.

[0011]

Furthermore, [the present invention also] relates to a method for manufacturing a 3D image display body which is used to display 3D images in which right-eye image display parts *a* and left-eye image display parts *b* are mixed, said 3D image display body manufacturing method being characterized by the fact that [a] a [laminated] phase-difference film 3 formed by laminating a TAC film 6 or CAB film, etc., that does not possess birefringence and a polycarbonate film 7 or drawn PVA film, etc., that possesses birefringence is disposed on a transparent support 1 with an adhesive agent 2 interposed so that the TAC film 6, etc., is located on the side of the adhesive agent 2, [b] specified portions of the polycarbonate film 7, etc., in this [laminated] phase-difference film 3 are then cut away by means of an ultra-hard blade 4, so that a plurality of grooves 8 which extend from one side [of the polycarbonate film, etc.,] to the other are formed side by side in the polycarbonate film 7, etc., and [c] a display member 5 is then superimposed on or bonded to the polycarbonate film 7, etc.

[0012]

Furthermore, [the present invention also] relates to a method for manufacturing a 3D image display body which is characterized by the fact that in the 3D image display body manufacturing method claimed in Claim 1 or Claim 2, the grooves 8 formed by removal [of the film] by means of an ultra-hard blade 4 are filled with an appropriate synthetic resin.

[0013]

[Operation and Effect of the Invention]

A plurality of grooves 8 which extend from one side [of the phase-difference film] to the other are formed in the phase-difference film by cutting away specified portions of the phase-difference film by means of an ultra-hard blade 4. Accordingly, since no phase-difference film is present in these groove parts, the property that the phase-difference film has of being able to rotate the direction of vibration of light in a specified wavelength region while maintaining the linearly polarized state [of the light] "as is" is naturally not exhibited. Consequently, a film is obtained in which the phase of the transmitted light is shifted 180° between the groove parts and the other parts.

[0014]

[Working Configurations of the Invention]

Figure 2 illustrates an embodiment of the present invention, which will be described below in detail.

[0015]

A phase-difference film (i.e., a film which has the property of being able to rotate the direction of vibration of light in a specified wavelength region while maintaining the linearly polarized state [of the light] "as is;" also called a 1/2-wave plate) is laminated on the surface of a transparent support 1 (e.g., a glass plate or cellulose acetate butyrate (CAB) plate, etc., with a

thickness of approximately 1 mm) with an adhesive agent 2 (e.g., an ultraviolet-curable resin) interposed, and the ultraviolet-curable resin is cured by means of ultraviolet light, so that a laminated phase-difference film 3 is formed. Furthermore, a glass plate that does not possess birefringence is most desirable as the support 1.

[0016]

This laminated phase-difference film 3 has a construction in which a polycarbonate film 7 (thickness: approximately 70 μm) which has a phase-difference function (90° rotation in a case where the optical axis and direction of vibration are set at 45°) as a result of possessing birefringence is laminated on a TAC film 6 (thickness: approximately 80 μm) with an adhesive agent 2 (e.g., an ultraviolet-curable resin) interposed. It would also be possible to laminate a uniaxially drawn PVA film (thickness: approximately 70 μm) that has similar properties instead of the [above-mentioned] polycarbonate film 7.

[0017]

A phase-difference film which uses a CAB film, etc., instead of the TAC film 6 of the set phase-difference film 3 may also be used; in short, any film in which a film that is substantially free of birefringence is laminated with a polycarbonate film 7, etc., may be used as the [above-mentioned] laminated phase-difference film 3. Furthermore, in cases where a polycarbonate film 7 is used, the TAC film 6 or CAB film, etc., may be omitted. However, in cases where a drawn PVA film is used, the strength of this drawn PVA film is insufficient; accordingly, a TAC film 6, etc., is required.

[0018]

Next, specified portions of the polycarbonate film 7 of the above-mentioned laminated phase-difference film 3 are cut away using an ultra-hard blade 4 (saw blade) with the shape shown in Figure 3, so that a plurality of parallel grooves 8 that extend from one side [of the polycarbonate film 7] to the other are formed side by side in the surface of the polycarbonate film 7. These grooves 8 have a width of 200 μm, and the pitch of the grooves is [also] 200 μm.

[0019]

Furthermore, the blade thickness of the ultra-hard blade 4 used in the present embodiment is 200 μm, the rpm is 10,000 rpm, and the feed rate is 450 mm/sec.

[0020]

In cases where a diamond cutter is used when the grooves 8 are thus formed in the polycarbonate film 7, favorable and efficient cutting is impossible (as was described above); however, when an ultra-hard blade 4 of the type employed in the present embodiment is used, the formation of the grooves 8 can be performed very efficiently.

[0021]

Furthermore, Table 1 shows comparative data obtained in a cutting test [comparing] a case in which the grooves 8 were formed in the laminated phase-difference film 3 of the present embodiment using a diamond cutter, and a case in which the grooves 8 were formed using an ultra-hard blade 4.

[0022]

[Table 1]

< Cutting Test >

	Feed rate mm/sec	10	20	30	400
Diamond cutter	Diamond powder No. 1700	×	×	×	×
	Diamond powder No. 1200	O	×	×	×
	Diamond powder No. 600	O	O	×	×
	Diamond powder No. 320	O	O	×	×
Ultra-hard blade		O	O	O	O

O: Good cutting possible.
×: Good cutting not possible.
cf. In the case of the diamond powder numbers, a larger number indicates a finer powder.

Parts where the aforementioned phase-difference function possessed by the polycarbonate film 7, etc., is not exhibited are created by removing portions of the laminated phase-difference film 3 as described above. These portions, i.e., the bottoms of the grooves 8, consist of a TAC film 6; accordingly, these bottom [portions] are used as (for example) right-eye image display parts *a*, while the remaining portions, i.e., [the portions where] the polycarbonate film 7 [remains], are used as left-eye image display parts *b*.

[0023]

Next, the above-mentioned grooves 8 are filled with an appropriate synthetic resin, e.g., an ultraviolet-curable resin. Furthermore, following this filling with a resin, a TAC film may be laminated on top. Such a TAC film is especially effective in cases where a drawn PVA film which has poor resistance to moist heat is used.

[0024]

As a result of cutting and removal by means of an ultra-hard blade 4, fine recesses and projections are formed in the inside surfaces of the grooves 8. However, as a result of the filling of the grooves 8 with a resin, the aforementioned fine recesses and projections are embedded, and a flat surface is obtained, so that the optical characteristics are improved.

[0025]

It has been confirmed that haze (degree of clouding) is greatly reduced in cases where the above-mentioned grooves 8 are filled with a resin compared to cases where the grooves 8 are not filled (in experiments, it was confirmed that in cases where [the grooves] are filled with a resin, the haze is reduced to half or less of the haze value seen in cases where [the grooves] are not embedded).

[0026]

Next, a display member 5 which has a liquid crystal inside is superimposed by means of a magnet, etc., or bonded by means of an appropriate adhesive agent, thus producing a 3D image display body.

[0027]

Furthermore, the positions of the grooves 8, i.e., the positions of the right-eye image display parts *a* and left-eye image display parts *b*, are set so that these positions coincide with the pitch of the liquid crystal cells of the display member 5.

[0028]

A film in which right-eye image display parts *a* and left-eye image display parts *b* are disposed side by side and which is superior in terms of optical characteristics can be obtained easily and efficiently by means of the above manufacturing method; accordingly, a 3D image display body which has a good function can also easily be obtained.

[0029]

Furthermore, if the respective members are provided in the form of rolls in the above-mentioned manufacturing [process], continuous manufacture is possible, so that the productivity of the 3D image display body is improved even further.

[0030]

When the image from the 3D image display body manufactured as described above is viewed through polarizing eyeglasses consisting of a polarizer-equipped right-eye lens that transmits only the right-eye image from the right-eye image display parts *a* and a polarizer-equipped left-eye lens that transmits only the left-eye image from the left-eye image display parts *b* (i.e., an image that is composed of light that vibrates in a direction that is 90° perpendicular to the direction of vibration of the light composing the right-eye image), the observer can experience the sensation of viewing the above-mentioned image as a three-dimensional image.

[0031]

In the present embodiment, as was described above, the right-eye image display parts *a* and left-eye image display parts *b* are not formed by a chemical treatment method. For example, in cases where the right-eye image display parts *a* and left-eye image display parts *b* are formed

by the aforementioned chemical treatment method, only a drawn PVA film that is relatively difficult to handle (i.e., which has a poor resistance to moist heat, etc.) can be used; an easy-to-handle polycarbonate film 7 cannot be used. In this regard, since the right-eye image display parts *a* and left-eye image display parts *b* are formed by the above-mentioned physical treatment method in the present embodiment, any type of material can be used to form the right-eye image display parts *a* and left-eye image display parts *b*; accordingly, an easy-to-handle polycarbonate film 7 can also be used, so that the productivity is correspondingly improved.

[0032]

In cases where a drawn PVA film is used, as was described above, the display member 5 is laminated after a TAC film, etc., which is used to prevent exposure of the drawn PVA film, is laminated on the upper surface. However, in the case of a polycarbonate film 7, such protection by means of a TAC film may be omitted, so that the productivity is improved in this respect as well in cases where a polycarbonate film 7 is used.

[0033]

Furthermore, if a member that does not possess birefringence is used as the support 1, the TAC film 6, etc., that is interposed between the polycarbonate film 7 or drawn PVA film and the support 1 becomes unnecessary. In this case, it is necessary to take care that no scratches are formed in the support 1 when the grooves 8 are formed in the polycarbonate film 7, etc., by means of the ultra-hard blade 4; accordingly, the thickness of the adhesive agent between the support 1 and the polycarbonate film 7*, etc., is set with this point taken into account (in this case, the adhesive agent used is also an adhesive agent that possesses no birefringence).

[Brief Description of the Drawings]

[Figure 1] Figure 1 is an explanatory diagram of a conventional 3D image [display] device.

[Figure 2] Figure 2 is a structural explanatory diagram of the present embodiment [of the present invention].

[Figure 3] Figure 3 is a front view of the ultra-hard blade used in the present embodiment.

[Explanation of Symbols]

1 Support
2 Adhesive agent
3 Laminated phase-difference film
4 Ultra-hard blade
5 Display member
6 TAC film

* Translator's note: original erroneously reads "1."

7 Polycarbonate film
8 Grooves
a Right-eye image display parts
b Left-eye image display parts